

CLAIMS

1. A user-interface method in which items are represented in an audio field by
 5 corresponding synthesized sound sources from where sounds related to the items appear to
 emanate, the method including the steps of:
 - (a) varying an offset between an audio-field reference relative to which the sounds sources
 are located in the audio field, and a presentation reference determined by a mounting
 configuration of audio output devices through which the sound sources are synthesised;
 10 and
 - (b) determining and visually indicating the orientation of the audio-field reference relative
 to a predetermined indicator reference taking account, at least at a component level, of
 any change in value of said offset and any change in value of indicator-reference
 orientation relative to the presentation reference, at least where such changes do not
 15 match each other.
2. A user-interface method according to claim 1, wherein in step (b) the orientation of the
 audio field reference relative to the indicator reference is determined from components of
 said offset and said indicator-reference orientation without intermediate determination of
 20 said offset and indicator-reference direction.
3. A user-interface method according to claim 1, wherein in step (b) determination of the
 orientation of the audio field reference relative to the indicator reference involves the
 intermediate determination of said offset and said indicator-reference orientation.
- 25 4. A user-interface method according to claim 1, wherein in step (a) the said offset
 comprises a component varied to stabilise audio field relative to one of:
 - a user's head;
 - a user's body;
 - 30 - a vehicle in which the user is travelling;
 - the world;

this stabilisation taking account of whether audio output devices used to synthesise the sound sources are world, vehicle, body or head mounted, and, as appropriate, rotation of the user's head or body, or turning of the vehicle.

5 5. A user-interface method according to claim 1 or claim 4, wherein in step (a) the said offset comprises a component varied in response to user input via an input device.

6. A user-interface method according to claim 1, wherein step (b) involves energising a selected indicator element of a set of such elements in dependence on the said orientation
10 of the audio field reference relative to the indicator reference.

7. A user-interface method according to claim 1, wherein step (b) involves displaying on a display screen an indication of the said orientation of the audio field reference relative to the indicator reference.
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8. A user-interface method according to claim 5, wherein step (b) involves indicating the said orientation of the audio field reference relative to the indicator reference via a visual orientation indicator arrangement that is incorporated into said input device.

20 9. A user-interface method according to claim 8, wherein said input device is a trackball device, the visual orientation indicator arrangement being a display screen.

10. A user-interface method according to claim 8, wherein said input device is a trackball device, the visual orientation indicator arrangement being a set of selectively energisable
25 indicator elements.

11. A user-interface method according to claim 8, wherein the location of new item-representing sound sources in the audio field is indicated to a user by using the visual orientation indicator arrangement to indicate the orientation of the new sound source
30 relative to said indicator reference.

12. A user-interface method according to claim 8, wherein the occurrence of an event relating to a said item is indicated to a user by using the visual orientation indicator arrangement to indicate the orientation of the corresponding sound source relative to said indicator reference.

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13. A user-interface method according to claim 1, including user selection of said predetermined indicator reference from multiple possible such references.

14. A user-interface method according to claim 1, wherein the sound sources are rendered through headphones and said offset remains unchanged by rotation of the user's head relative to their body whereby to stabilise the audio field relative to the user's head; said predetermined indicator reference being one of:

- current facing direction, in which case step (b) takes account of any changes, at least at a component level, in said offset, there being no change in the orientation of the indicator reference relative to the presentation reference;
- straight-ahead facing direction in which case step (b) takes account, at least at a component level, of both any changes in said offset, and changes in the orientation of the indicator reference relative to the presentation reference resulting from rotation of the user's head relative to their body;
- a direction fixed relative to the world, in which case step (b) takes account, at least at a component level, of both of any changes in said offset, and changes in orientation of the indicator reference relative to the presentation reference resulting from rotation of the user's head relative to the world.

13. A user-interface method according to claim 1, wherein the sound sources are rendered through headphones and step (a) involves varying said offset in dependence on the rotation of the user's head relative to their body whereby to stabilise the audio field relative to the user's body; said predetermined indicator reference being one of:

- current facing direction, in which case step (b) takes account, at least at a component level, of changes in said offset, there being no change in the orientation of the indicator reference relative to the presentation reference;

- straight-ahead facing direction in which case step (b) takes account, at least at a component level, of changes in said offset except that changes in offset resulting from rotation of the user's head relative to their body are matched out by the changes in the orientation of the indicator reference relative to the presentation reference;
 - 5 - a direction fixed relative to the world, in which case step (b) takes account, at least at a component level, of both of changes in said offset, and changes in orientation of the indicator reference relative to the presentation reference resulting from rotation of the user's body relative to the world.
- 10 14. A user-interface method according to claim 1, wherein the sound sources are rendered through headphones and step (a) involves varying said offset in dependence on the rotation of the user's head relative to the world whereby to stabilise the audio field relative to the world; said predetermined indicator reference being one of:
- current facing direction, in which case step (b) takes account, at least at a component
 - 15 level, of changes in said offset, there being no change in the orientation of the indicator reference relative to the presentation reference;
 - straight-ahead facing direction in which case step (b) takes account, at least at a component level, of changes in said offset except that components of offset changes resulting from rotation of the user's head relative to their body are matched out by the
 - 20 changes in the orientation of the indicator reference relative to the presentation reference;
 - a direction fixed relative to the world, in which case step (b) takes account, at least at a component level, of changes in said offset except that changes in offset resulting from rotation of the user's head relative to the world are matched out by the changes
 - 25 in the orientation of the indicator reference relative to the presentation reference.
17. A user-interface method according to any one of claims 12 to 14, wherein the changes in the said offset include user-commanded changes.
- 30 18. A user-interface method according to claim 1, wherein the orientation of the audio-field reference relative to a predetermined indicator reference has at least two degrees of freedom.

19. A user-interface method according to claim 1, wherein the indicator reference is one of:
- the presentation reference;
 - 5 - a current facing direction of the user;
 - a straight-ahead facing direction of the user;
 - a world-fixed direction.
20. An audio user-interfacing method in which each of a plurality of items is represented in an audio field by at least one respective synthesized sound source from where sounds related to the item appear to emanate, the method comprising the steps of:
- (a) setting the location of each sound source relative to an audio-field reference;
 - (b) controlling an offset between the audio-field reference and a presentation reference determined by a mounting configuration of the audio output devices, this offset being varied both in response to user input and to achieve a particular stabilisation of the audio field;
 - 15 (c) determining a rendering position for each sound source by combining the location of the sound source in the audio field with said offset;
 - (d) rendering said sound sources at their associated rendering positions in the audio field;
 - 20 and
 - (e) determining and visually indicating the orientation of the audio field reference relative to a predetermined indicator reference direction taking account, at least at a component level, of any change in said offset and any change the orientation of said indicator reference direction relative to the presentation reference, at least where such changes do not match each other.
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21. Apparatus for providing an audio user interface in which each of a plurality of items is represented in an audio field by at least one respective synthesized sound source from where sounds related to the item appear to emanate, the apparatus including:
- 30 - offset means for varying an offset between an audio-field reference relative to which the sounds sources are located in the audio field, and a presentation reference determined by a mounting configuration of audio output devices of the apparatus

through which the sound sources are synthesised;

- orientation-determining means for determining the orientation of the audio-field reference relative to a predetermined indicator reference taking account, at least at a component level, of any change in value of said offset and any change in value of indicator-reference orientation relative to the presentation reference, at least where such changes do not match each other; and
- a visual orientation indicator arrangement for visually indicating the said orientation determined by the orientation-determining means.

10 22. Apparatus according to claim 21, wherein the orientation-determining means is operative to determine the orientation of the audio field reference relative to the indicator reference on the basis of components of said offset and said indicator-reference orientation without intermediate determination of said offset and indicator-reference direction.

15 23. Apparatus according to claim 21, wherein the orientation-determining means is operative to determine the orientation of the audio field reference relative to the indicator reference through the intermediate determination of said offset and said indicator-reference orientation.

20 24. Apparatus according to claim 21, wherein the offset means is operative to vary said offset such as to stabilise audio field relative to one of:

- a user's head;
- a user's body;
- a vehicle in which the user is travelling;
- 25 - the world;

this stabilisation taking account of whether the audio output devices used to synthesise the sound sources are world, vehicle, body or head mounted, and, as appropriate, rotation of the user's head or body, or turning of the vehicle.

30 25. Apparatus according to claim 21 or claim 24, wherein the offset means is operative to vary the said offset in response to user input via an input device of the apparatus.

26. Apparatus according to claim 21, wherein the visual orientation indicator arrangement comprises a set of selectively energisable indicator elements, one of the orientation-determining means and the visual orientation indicator arrangement including means for energising a selected one of the elements in dependence on the determined orientation of the audio field reference relative to the indicator reference.

27. Apparatus according to claim 21, wherein the visual orientation indicator arrangement comprises a display screen, one of the orientation-determining means and the visual orientation indicator arrangement including means for causing the display on the screen of an indication of the determined orientation of the audio field reference relative to the indicator reference.

28. Apparatus according to claim 25, wherein the visual orientation indicator arrangement is incorporated in the input device.

29. Apparatus according to claim 28, wherein said input device is a trackball device, the visual orientation indicator arrangement comprising a display screen, and one of the orientation-determining means and the visual orientation indicator arrangement including means for energising a selected one of the elements in dependence on the determined orientation of the audio field reference relative to the indicator reference.

30. Apparatus according to claim 28, wherein said input device is a trackball device, the visual orientation indicator arrangement comprising a set of selectively energisable indicator elements, and one of the orientation-determining means and the visual orientation indicator arrangement including means for energising a selected one of the elements in dependence on the determined orientation of the audio field reference relative to the indicator reference.

31. Apparatus according to claim 28, further comprising means for indicating the location of new item-representing sound sources in the audio field by using the visual orientation indicator arrangement to indicate the orientation of the new sound source relative to said indicator reference.

32. Apparatus according to claim 28, further comprising means for indicating the occurrence of an event relating to a said item by using the visual orientation indicator arrangement to indicate the orientation of the corresponding sound source relative to said indicator reference.

33. Apparatus according to claim 21, wherein the orientation of the audio-field reference relative to a predetermined indicator reference has at least two degrees of freedom.

34. Apparatus according to claim 21, wherein the indicator reference is one of:

- the presentation reference;
- a current facing direction of the user;
- a straight-ahead facing direction of the user;
- a world-fixed direction.

35. Apparatus for providing an audio user interface in which each of a plurality of items is represented in an audio field by at least one respective synthesized sound source from where sounds related to the item appear to emanate, the apparatus including:

- a control arrangement for varying an offset between an audio-field reference relative to which the sounds sources are located in the audio field, and a presentation reference determined by a mounting configuration of audio output devices of the apparatus through which the sound sources are synthesised;
- an orientation-determining arrangement operative to determine the orientation of the audio-field reference relative to a predetermined indicator reference taking account, at least at a component level, of any change in value of said offset and any change in value of indicator-reference orientation relative to the presentation reference, at least where such changes do not match each other; and
- a visual orientation indicator arrangement for visually indicating the said orientation determined by the orientation-determining means.

36. Apparatus for providing an audio user interface in which each of a plurality of items is

represented in an audio field by at least one respective synthesized sound source from where sounds related to the item appear to emanate, the apparatus comprising:

- means for setting the location of each said sound source relative to an audio-field reference;
- 5 - offset means for controlling an offset between the audio-field reference and a presentation reference determined by a mounting configuration of the audio output devices;
- means for deriving the rendering position of each sound source based on the location of the sound source in the audio field and said offset;
- 10 - rendering means, including audio output devices, for generating an audio field in which said sound sources are synthesized at their associated rendering positions to provide sounds related to the items concerned; and
- a visual indicator arrangement for determining and visually indicating the orientation of the audio field reference relative to a predetermined indicator reference taking
- 15 account, at least at a component level, of any change in said offset and any change the orientation of said indicator reference direction relative to the presentation reference, at least where such changes do not match each other.

37. In apparatus for providing an audio user interface in which each of a plurality of items
20 is represented in an audio field by at least one respective synthesized sound source from where sounds related to the item appear to emanate, an input device comprising:

- at least one user-operable element, with associated sensing means, for commanding a change in offset between an audio-field reference relative to which the sounds sources are located in the audio field, and a presentation reference determined by a
- 25 mounting configuration of audio output devices through which the sound sources are synthesised; and
- a visual orientation indicator arrangement for visually indicating the orientation of the audio field reference relative to a predetermined indicator reference, the visual orientation indicator arrangement comprising a set of selectively energisable
- 30 indicator elements.

38. In apparatus for providing an audio user interface in which each of a plurality of items is represented in an audio field by at least one respective synthesized sound source from where sounds related to the item appear to emanate, an input device comprising:

- 5 - at least one user-operable element, with associated sensing means, for commanding a change in offset between an audio-field reference relative to which the sounds sources are located in the audio field, and a presentation reference determined by a mounting configuration of audio output devices through which the sound sources are synthesised; and
- 10 - a visual orientation indicator arrangement for visually indicating the orientation of the audio field reference relative to a predetermined indicator reference, the visual orientation indicator arrangement comprising a visual display screen.

39. In apparatus for providing an audio user interface in which each of a plurality of items is represented in an audio field by at least one respective synthesized sound source from where sounds related to the item appear to emanate, an input device comprising:

- 15 - at least one user-operable mechanical element with at least two degrees of freedom and associated sensing means, for commanding a change in offset between an audio-field reference relative to which the sounds sources are located in the audio field, and a presentation reference determined by a mounting configuration of audio output devices through which the sound sources are synthesised; and
- 20 - a visual orientation indicator arrangement for visually indicating the orientation of the audio field reference relative to a predetermined indicator reference, the visual orientation indicator arrangement comprising markings on an external surface of the user-operable element.

40. In apparatus for providing an audio user interface in which each of a plurality of items is represented in an audio field by at least one respective synthesized sound source from where sounds related to the item appear to emanate, the input device of claim 39 wherein the user-operable element is a trackball.

41. In apparatus for providing an audio user interface in which each of a plurality of items is represented in an audio field by at least one respective synthesized sound source from

where sounds related to the item appear to emanate, the input device of claim 39 wherein the user-operable element is a cylinder that is displaceable along, and rotatable about, its axis.

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